ODC

Quarterly Status Report Number 15

NEODYMIUM LASER GLASS IMPROVEMENT PROGRAM

ARPA Order Number 306-20

Project Code Number 7300

Contract Number Nonr 3835(00)

Office of Naval Research
Navy Department
Washington, D. C.

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During the three month period ending 31 December 1965, the studies directed toward the athermalization of laser glass have been continued. The main areas of investigation were: (1) measurement of the thermal coefficient of refractive index, and (2) design of a system for measuring the stress-optical coefficient.

THERMAL COEFFICIENT OF REFRACTIVE INDEX

As previously reported a series of glasses has been designed to study the effects of glass composition on the various temperature dependent parameters involved in the athermalization study. Measurements required for the calculation of the thermal coefficient of refractive index, α_n, have recently been completed for this series of glasses. As soon as the calculations are finished an attempt will be made to perform a regression analysis on the resulting α_n values as a function composition.

The glass compositions in the above series were chosen systematically to provide data on a wide variety of ingredients and not on the basis of the merit of any given composition with respect to a given glass property. One should, therefore, not expect any of these glasses to be an ideal composition. Despite this fact we have chosen the most promising glass in this series and will compare its athermal properties with our commercial laser glass. The composition was modified slightly to make the glass a more suitable laser material. The pertinent properties of a 1 lb. melt of this modified composition have been measured to be sure that the modifications did not alter the properties. A larger melt is planned in the near future which will be capable of providing the optical quality required for a study of the induced changes in optical homogeneity due to the pumping process.

STRESS-OPTICAL COEFFICIENT

As previously reported, measurement of the change in optical path length $\Delta(nL)$ as a function of pressure has lead to the determination of the stress-optical coefficients $B_\perp$ and $B_\parallel$ for those glasses for which the elastic constants were known. In the method used, the elastic constants were required to calculate the change in sample thickness, ΔL, for a given applied pressure. With this calculated value of ΔL and the measured value of $\Delta(nL)$ it is possible to calculate $B_\perp$ and $B_\parallel$, the changes in refractive index per unit of applied pressure.

Rather than determine the elastic constants for the various glasses in the above mentioned series, a system is now being tested in which the change in physical thickness ΔL is a measured value. This may be accomplished in our interferometric measuring technique by silvering a portion of the sample so that the physical distortion of the sample can be monitored as the change in optical path length is being measured. Other techniques, such as changing the wavelength of the interferometer light source, are also being considered as a means of separating the effects of ΔL from those of Δn on the observed change in optical path length $\Delta(nL)$.